

Thermal Systems Integration for Fuel Economy

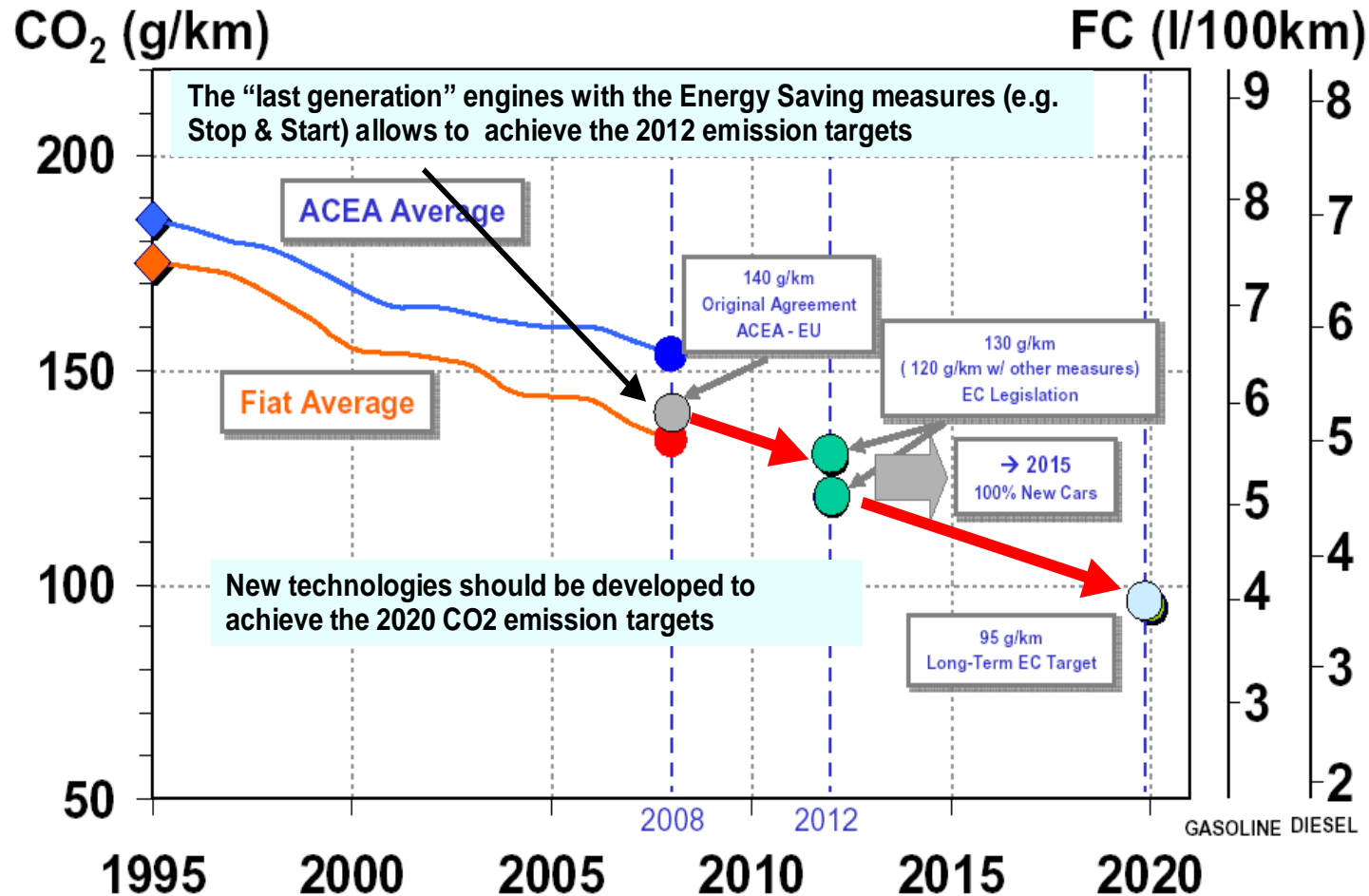
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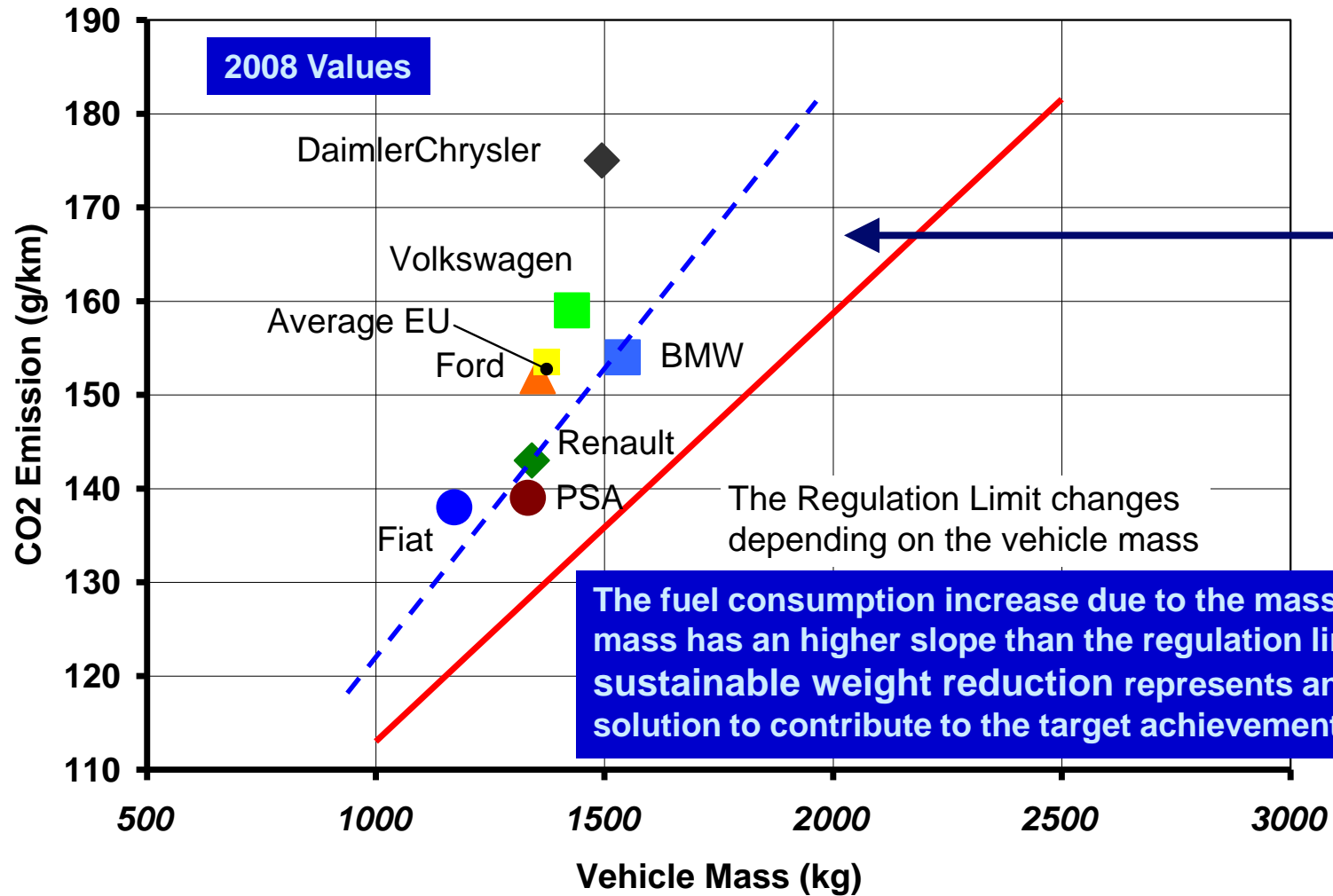
Summary

- Motivations
- Project objectives
- The basic concept
- Consortium
- WorkFlow and Timing
- Expected results

CO₂ Emissions in Europe



EU Major OEM positioning

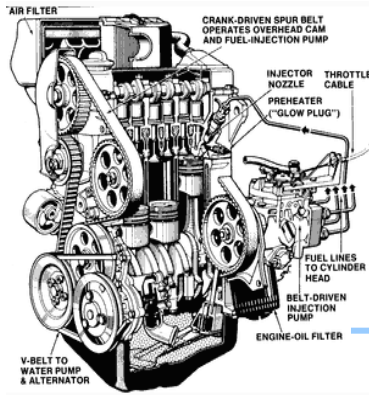


The Combustion Energy Use

30% Mechanical Energy



1 Liter of Fuel



The Engine converts the combustion energy



32% Exhaust gas

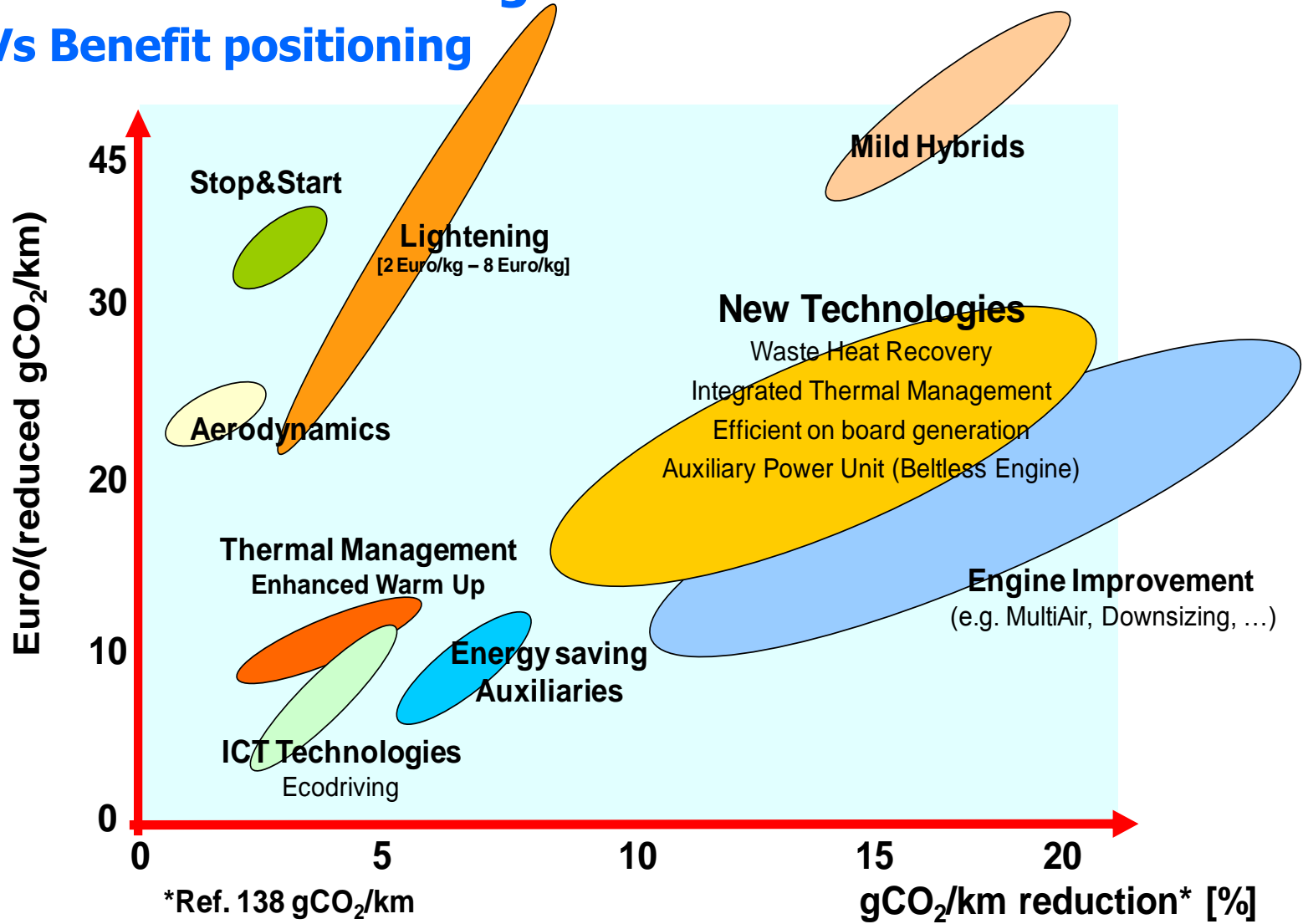
6% Others

32% Coolant

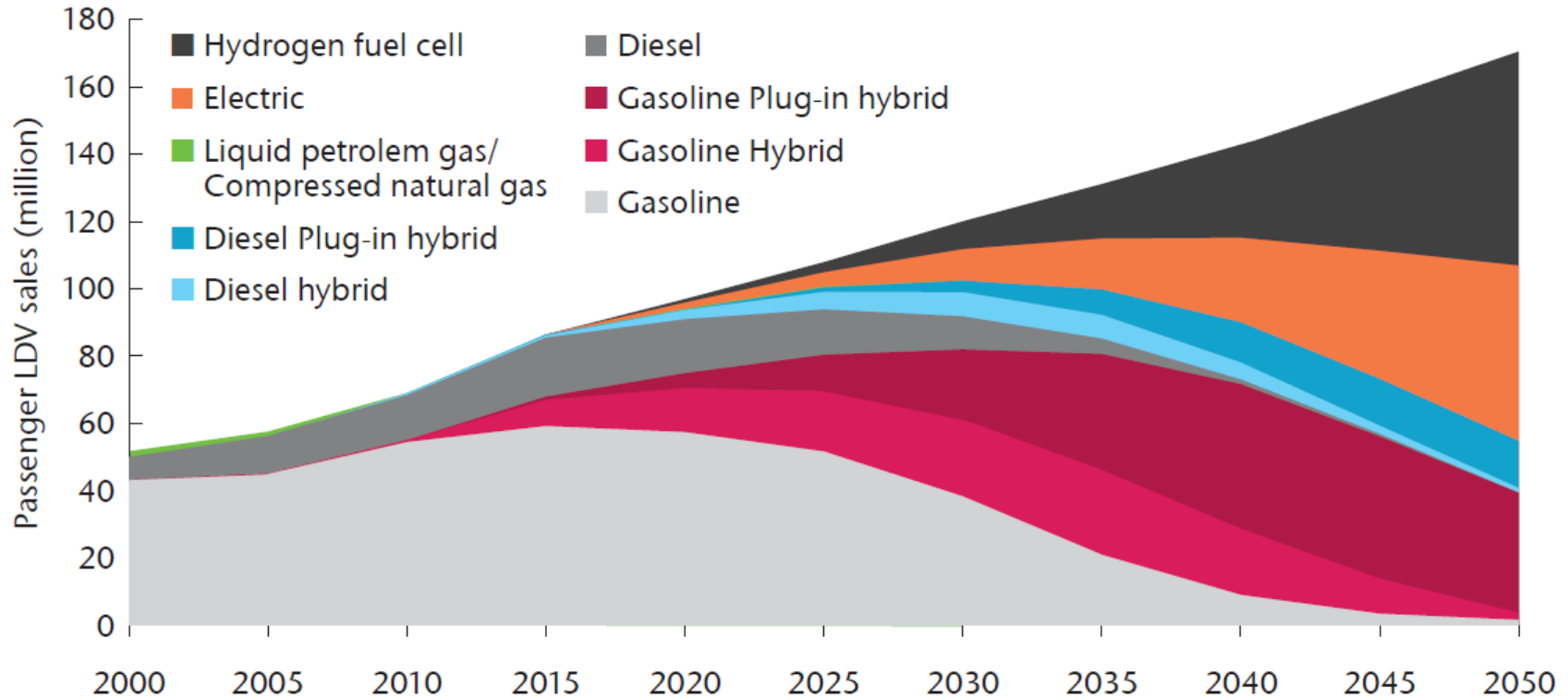


CO₂ Reduction Technologies

Cost Vs Benefit positioning



Passenger Cars Scenario



Source: IEA 2009.

Technologies

The **Heat Management and Re Use** represents the greatest opportunity to increase the effectiveness of the

- New Generation of Engines
- Hybrid Powertrains
- Electric Vehicles

Conclusions

The incoming regulations on CO₂ emissions requires the development and implementation of **innovative and economically sustainable technologies**

The diffusion of the electrical vehicles will contribute to reduce the overall GHG emission of the passenger cars sector.

The major benefits are expected from:

- powertrain efficiency increase thanks to the improvement of the combustion control and of the subsystems
- energy recovery (kinetic and thermal)
- vehicle innovative and lighter subsystems

The Thermal Management and Thermal Systems Integrations offer a great opportunity to improve the overall vehicle efficiency

CHALLENGES

Challenge 1: CO₂ emission reduction

Challenge 2: Fuel Consumption Reduction in Real Use

Challenge 3: New Refrigerants

Challenge 4: Alternative Powertrain

Project Major Objectives

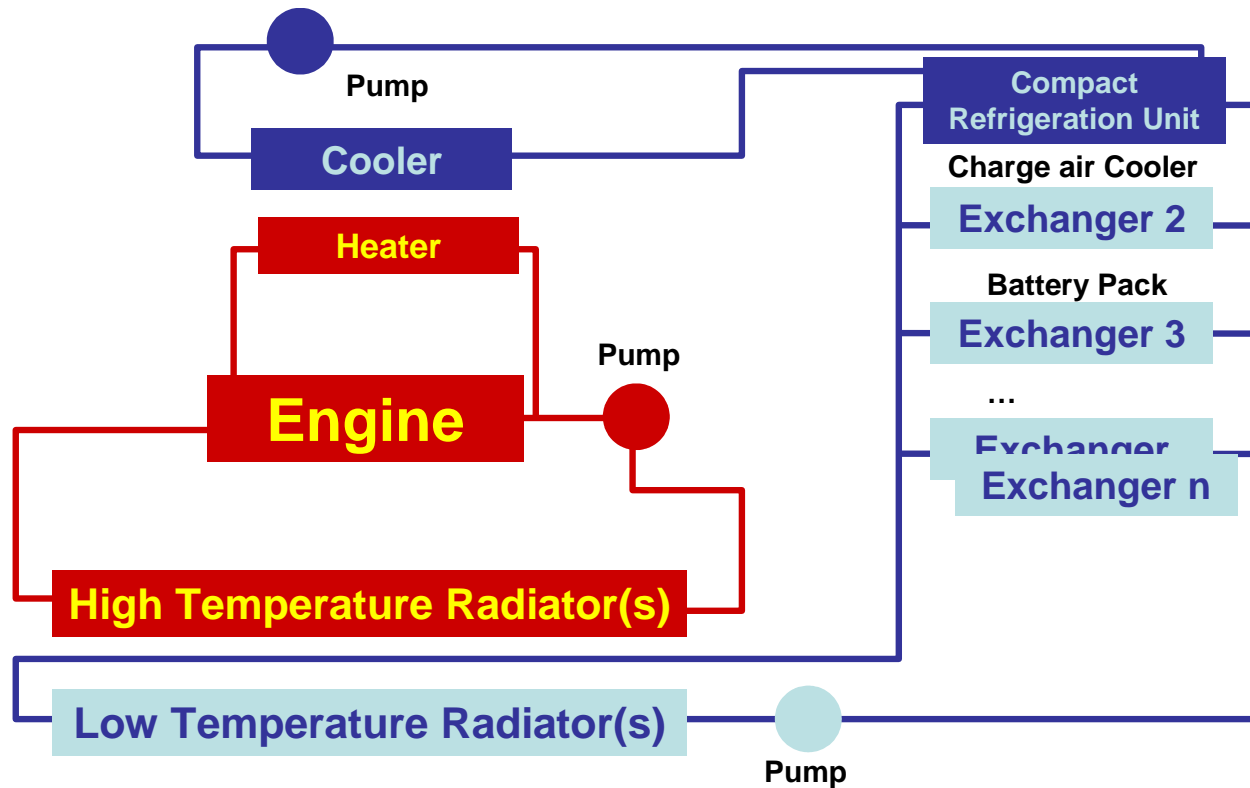
To develop a new **Integrated Thermal System** able to enhance the heat rejection and management.

The concept is based on the **integration** of engine cooling, air conditioning, battery cooling (in case of hybrid), ... and on the development of a new generation of coolant fluid (**nanofluids**) and **heat exchangers**.

Expcted results:

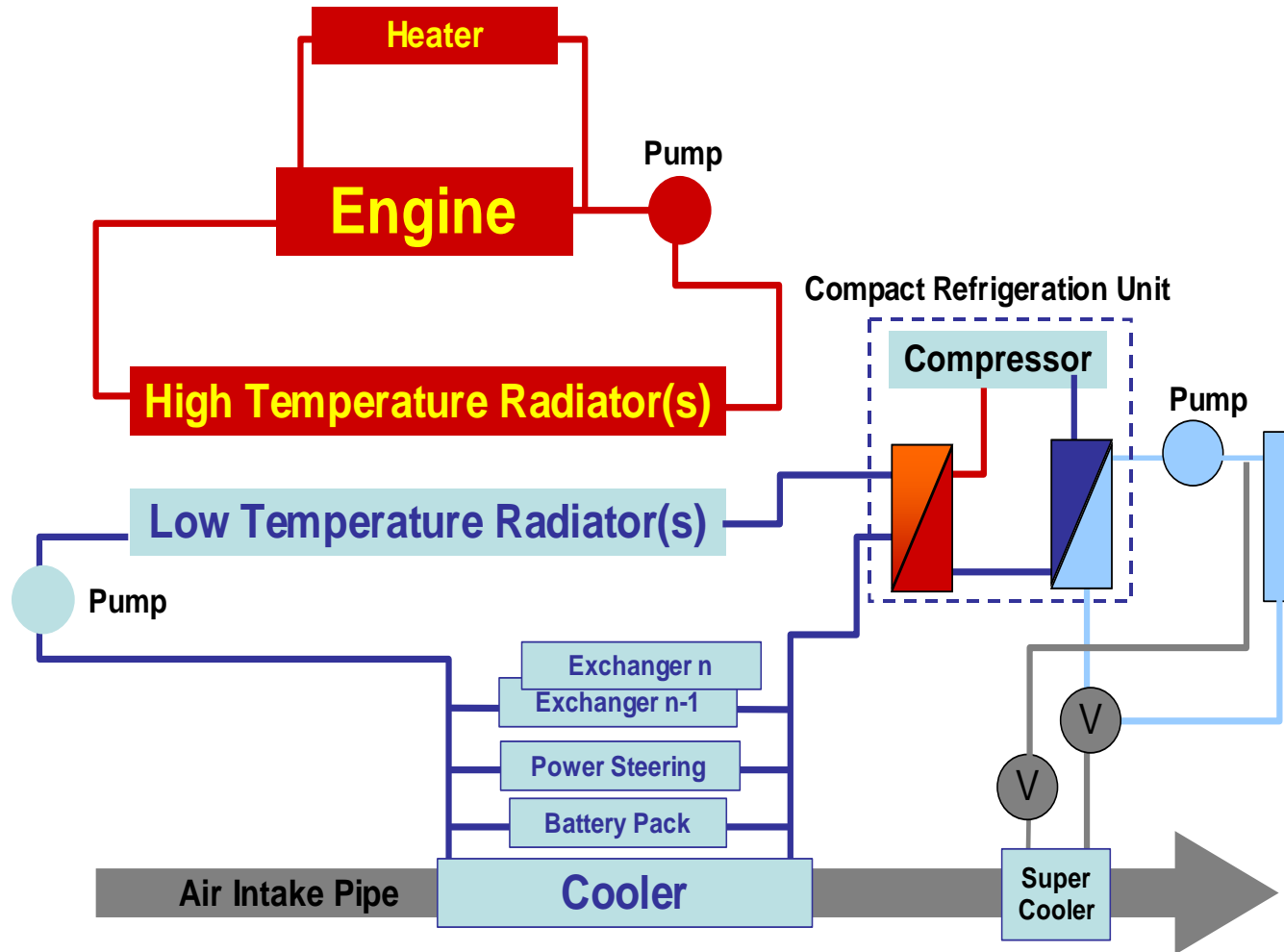
- Reduction of vehicle fuel consumption of about the 15% in real use
- Lay out simplification
- Cost reduction (due to resize of the systems and their integration)

The basic TIFFE Approach



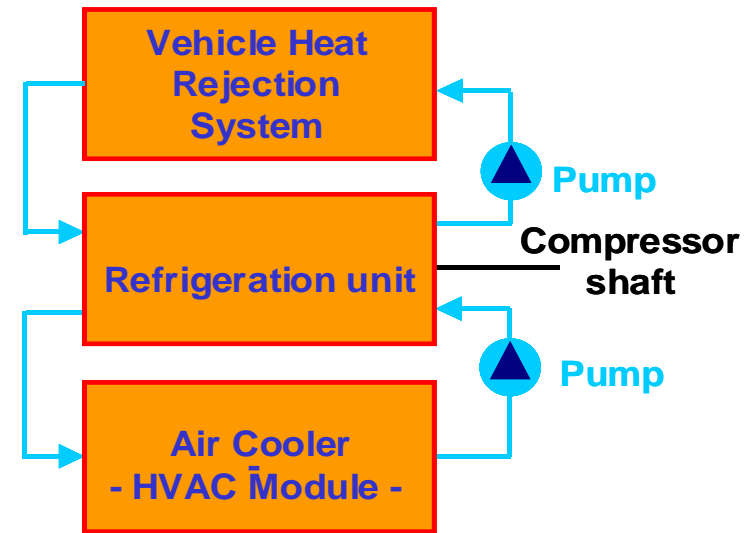
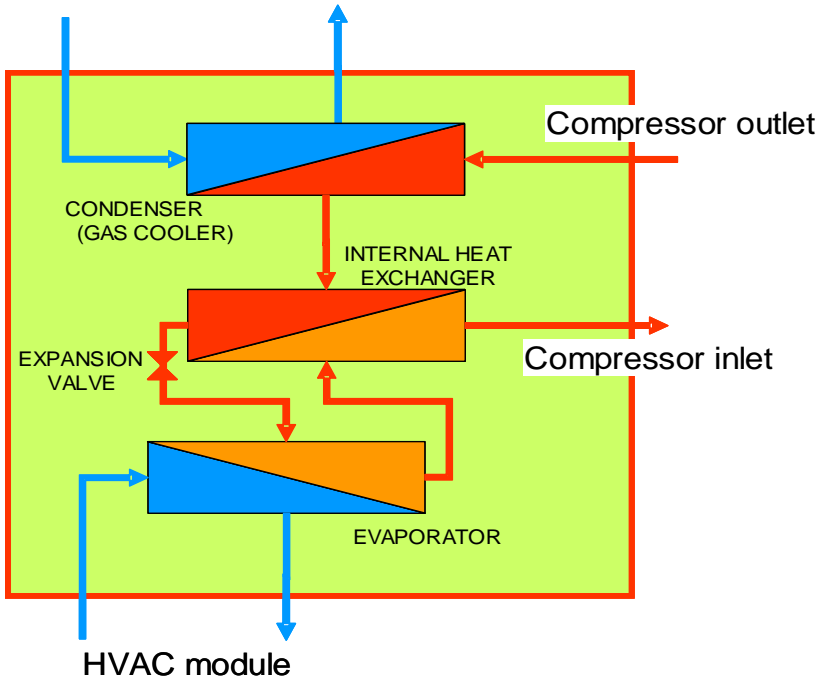
TIFFE basic concept: two cooling loops one for the engine and one for all the other vehicle auxiliary systems plus one loop dedicated to the transfer of the cooling power

The basic TIFFE Approach



Compact Refrigeration Unit

Vehicle Heat Rejection system



The air conditioning is a module with 4 coolant hoses (two on the cold side and two on the hot side) and the connections with the compressor. The Expansion Device and other components like the Internal Heat Exchanger are integrated in the package of the Unit.

Advantages

Air Conditioning

- Safer use of flammable refrigerants
- Reduced A/C fuel consumption thanks to the improved and homogeneous condensation (-10%)
- Reduced refrigerant charge (-50%)
- Higher comfort in case of Stop & Start or mild hybrids

Vehicle

- Compact air intake system
- Simpler thermal model
- Modular approach to heat rejection
- Reduced heat exchanger

EU Support

- The Project costs 3.6 Millions of Euro
- The EU supports the project in the framework of the “The Greening of Surface Transport” research program
- TIFFE is an EUCAR project



The Consortium

Centro Ricerche Fiat

Maflow

SINTEF Energy Research

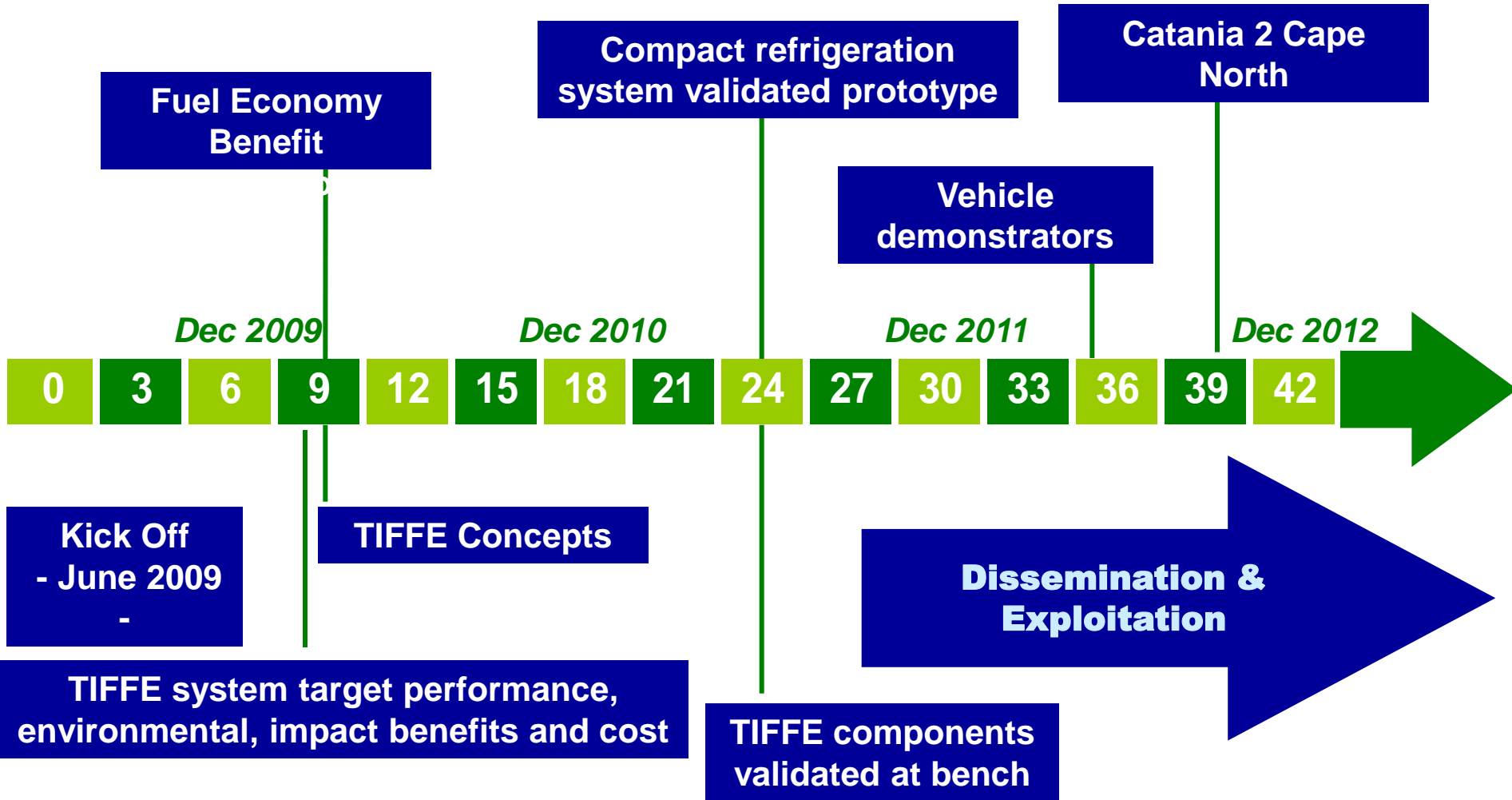
Technische Universität Braunschweig
Inst. für Thermodynamik

Ford Werke GmbH

DENSO Thermal System



Timing



Expected Final Results and their Use/Impact

The major expected final results are:

- a new vehicle thermal system improving the heat rejection and the fuel economy both for LCVs and passenger cars
- a compact refrigeration unit (water cooled condenser, chiller, internal heat exchanger, expansion device, compressor)

The developed system will be the basis of future:

- power train cooling (water cooled, charge air cooler, ...)
- auxiliary systems cooling (battery, generator, electronics...)
- air conditioning system: semi hermetic compact system
- new coolant fluids with enhanced heat transfer properties

THANK YOU!

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